Operational and related science considerations for the evaluation of MSL landing sites: A case for Mawrth Vallis

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Disclaimer

- **This presentation is intended to stimulate thought and discussion**
- **This presentation is NOT intended to be inflammatory**

Overview

- **Go-to sites are scientific avarice**
- **Ground-truthing of phyllosilicates should be second only to finding organics**
- **In-ellipse science potential should be used to prioritize go-to sites**

Why Go-To?

- **Results from the 4th MSL Landing Site Workshop:"There was unanimous agreement from workshop participants that all four of the sites represent acceptable science targets for exploration by MSL"**

- **Question: Is the science potential of any go-to site worth the additional time and risk compared to the land-on site?**

Go-To = Additional Time

- **MSL PIP indicates:**
  - 100-200 m/sol drive capability
  - Example mission scenario assumes 50 m/sol on traverse sols
- **Example: A 10 km path to exit an ellipse requires 200 sols assuming 50 m/sol and driving on every sol, i.e., no extended science campaigns**

Spirit Example

Sol 107

Bonneville Crater

2 km

Missoula Crater

Lahontan Crater

Sol 156

Husband Hill

Eldorado

On sol 107, initiated "sol quartet" (1 sol of science, 3 sols of driving) ; arrived at the West Spur on sol 156; traversed 2 km in 49 sols = ~41 m/sol

Image NASA / JPL / University of Arizona

1000 m

14°34'33.30" S   175°30'04.53" E   elev −1941 m

Google
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Eye alt   1.43 km

Opportunity Example

On sol 317, departed Endurance crater without a designated drive strategy; arrived at Victoria crater on sol 952; traversed 6 km in 635 sols = ~9 m/sol

Go-To = Additional Risk

- **MSL PIP: "MSL will investigate a site that shows clear evidence for ancient aqueous processes based on orbital data and undertake the search for past and present habitable environments."**

- **If the ellipse shows no such evidence and Curiosity fails to exit the ellipse, then major science objectives may not be met**

- **Failure to exit ellipse could result from unforeseen trafficability, mobility, or software problems**

Go-To = Additional Risk
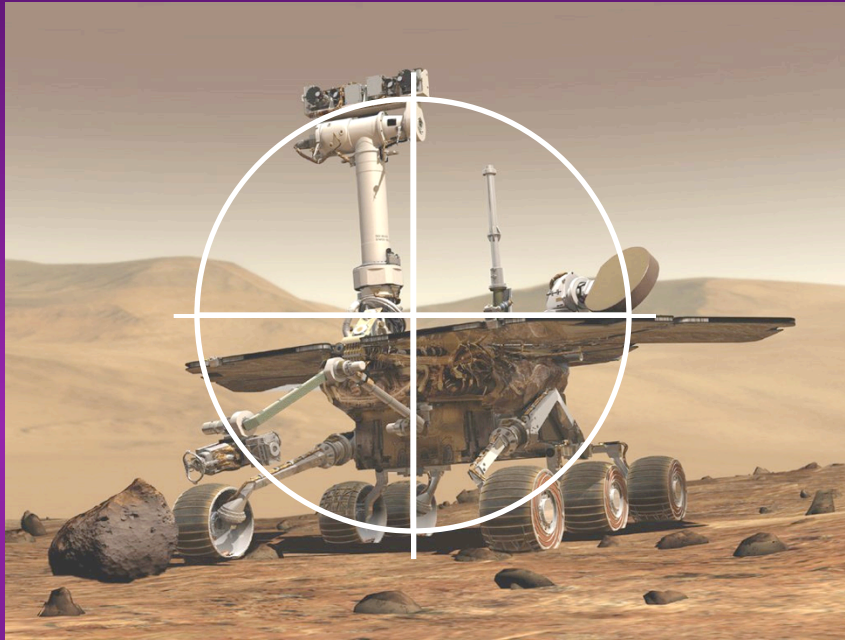
Spirit gotchas:

Software - flash memory

Mobility - wheel motor

Trafficability - Troy sand trap

Opportunity gotchas:

Trafficability - Purgatory ripple

- **Failure to exit ellipse could result from unforeseen trafficability, mobility, or software problems**

Ground-truthing Phyllosilicates

- **The discovery of phyllosilicates has fundamentally changed our view of Mars**

- **The presence or absence of phyllosilicates drives our landing site decisions**

Bibring et al. [2006]

- **A multitude of mineral phases identified from orbit have been positively identified in situ, including those aqueously derived, *but not phyllosilicates***

Fig. 3. Global map of hydrated minerals (**top**) plotted over a MGS Mars Orbiter Laser Altimeter (MOLA) altitude reference map (**bottom**). Red, phyllosilicates; blue, sulfates; yellow, other hydrated minerals, with no marked feature (such as being driven by metal-OH vibration) enabling the identification.
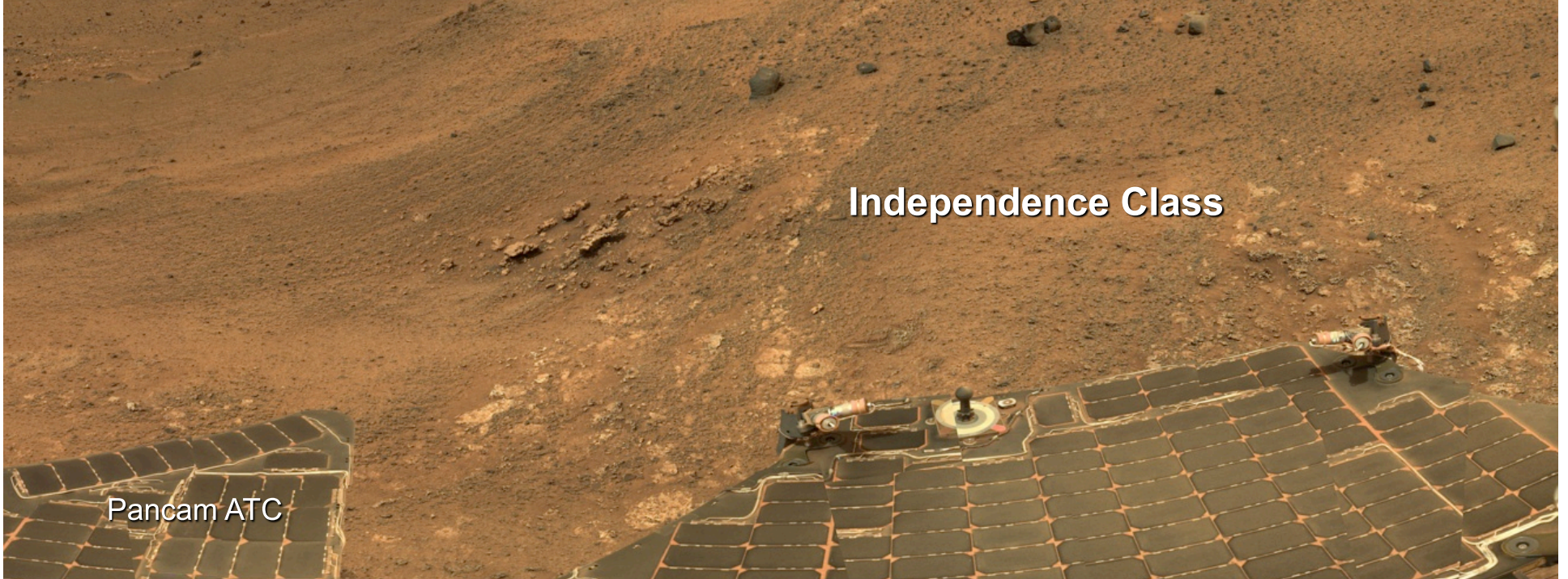
Phyllos in Gusev?

Evidence for montmorillonite or its compositional equivalent in Columbia Hills, Mars

B. C. Clark III,[1] R. E. Arvidson,[2] R. Gellert,[3] R. V. Morris,[4] D. W. Ming,[4] L. Richter,[5] S. W. Ruff,[6] J. R. Michalski,[6] W. H. Farrand,[7] A. Yen,[8] K. E. Herkenhoff,[9] R. Li,[10] S. W. Squyres,[11] C. Schröder,[12] G. Klingelhöfer,[12] and J. F. Bell III[11]
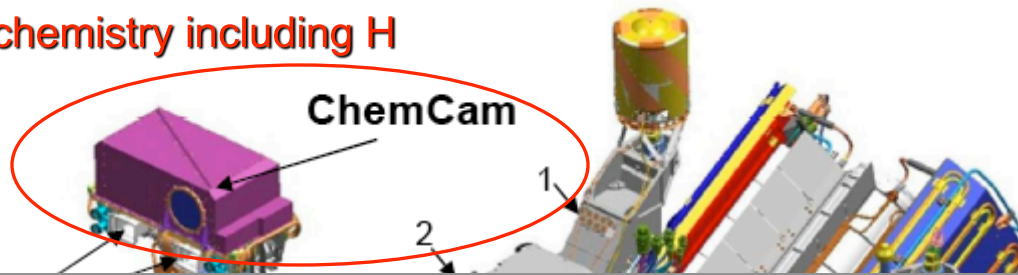
Independence Class

Pancam ATC

Finding Phyllos with MSL

Remote chemistry including H

ChemCam

The apparent abundance and extent of phyllosilicates at Marwth Vallis will help ensure that we locate and understand their significance with regard to habitability and climate

SAM Inlets

CheMin Inlet

APXS & MAHLI

Onboard mineralogy; most phyllos

MARDI camera head

Summary

- **Landing at Mawrth Vallis provides the opportunity to investigate the habitability of one of the largest and most altered locations on Mars *immediately after landing***

- **Unless a go-to site is demonstrably superior to Marwth Vallis scientifically, then *we shouldn't encumber the MSL mission* with the additional time and risk of a long drive**